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PENSOFT

New records of pseudoscorpions (Arachnida, Pseudoscorpiones) from the Caatinga biome, Brazil: a checklist and a map of species richness distribution

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Abstract

In the course of ongoing research on the pseudoscorpion fauna in the northeastern region of Brazil, we compiled nine pseudoscorpion species with three of them, *Geogarypus amazonicus*, *Apolpium ecuadorense*, and *Pachyolpium furculiferum*, recorded for the first time from the Caatinga biome. Ecological comments are included, and the presence of *G. amazonicus* is discussed. Additionally, an updated checklist of all pseudoscorpion species and a map of the distribution of species richness for all biomes of Brazil are presented.

Keywords

Microhabitat, Northeast Region of Brazil, Pseudoscorpiones, zoogeography.

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Introduction

Pseudoscorpions are small arachnids that are characterized by silk glands associated with the chelicerae, well-developed pedipalps that culminate in a chela that in many families includes venom glands at the ends the fingers of the chela, the absence of a telson, and external reproduction via spermatophore (Weygoldt 1969; Harvey 1992; Del-Claro and Tizo-Pedroso 2009; Zaragoza 2015). Pseudoscorpions have a cosmopolitan distribution and have colonized most terrestrial ecosystems (Weygoldt 1969; Del-Claro and Tizo-Pedroso 2009). In terms of diversity, it is considered a meso-diverse group, with roughly 3,850 species described worldwide (Harvey 2013; Benavides et al. 2019).

Currently, 174 species distributed in 66 genera and 16 families have been reported from Brazil (Ratton et al. 2012; Harvey 2013; Von Schimonsky et al. 2014; Harvey et al. 2016; Viana et al. 2018; Von Schimonsky and Bichuette 2019; Viana and Ferreira 2020). In the

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Northeast Region of Brazil, little research has been done on the pseudoscorpion fauna (e.g., Lira et al. 2014; Lira and Tizo-Pedroso 2017). Most reports in the literature are from the North, Southeast, and South regions of the country (Harvey 2013). Considering the varied habitats across the country, some authors have suggested a close relationship of the pseudoscorpion abundance with the vegetal complexity structure of these habitats (Weygoldt 1969; Gabbutt 1970; Morais et al. 1997; Aguiar et al. 2006). Pseudoscorpions also occupy one or more specific microhabitats (Battirola et al. 2017; Torres and Bedoya-Roqueme 2018).

In the Caatinga, the unique biome entirely within the borders of Brazil, there are no reports of pseudoscorpions and no investigations have been carried out on this group. This biome corresponds to approximately 70% of northeastern Brazil and is represented by 13 phyto-physiognomies that vary from open shrub vegetation to closed arboreal forest (Silva et al. 2017; Lira et al. 2019). In addition, the Caatinga biome is threatened by the unsustainable exploitation of native wood, conversion to pastures and plantations, and the increased risk of desertification due to the global climate change (Ribeiro et al. 2015; Vieira et al. 2015; Ribeiro-Neto et al. 2016; Leal et al. 2018; Bravo and Calor 2014; Santos-da-Silva et al. 2017; Carvalho and Botero-Trujillo 2019). However, there is still a large knowledge gap for many invertebrate groups, such as pseudoscorpions, possibly due the lack of specialists is this group. For this reason, we thought it important to initiate studies on the pseudoscorpion fauna of the Caatinga, and the aim of this study is to determine the taxonomic diversity in this region of Brazil. In addition, we also compile a list of the Brazilian pseudoscorpion fauna.

Methods

Specimens were collected from four different locations in August 2012 (dry season) and January 2015 (wet season) in the central region of Caatinga biome, in northeastern Brazil (Fig. 1). The two locations were: Iguaracy municipality, Pernambuco, Brazil, 07°46′27″S, 037°13′36″W; Cumaru municipality, Pernambuco, 08° 00′21″S, 035°41′49″W; Buíque municipality, Pernambuco, 08°30′57″S, 037°20′59″W; Brejinho municipality, Pernambuco, 07°18′11″S, 037°20′10″W. The climate of the Caatinga biome is tropical semi-arid, marked by a mean annual temperature of 27 °C, ranging from 25 °C to over 32 °C. In the dry season, precipitation is typically 800 mm, but in the driest years this may reach 200 mm. During the wet season, rainfall can reach 1000 mm. Caatinga vegetation includes many endemic species

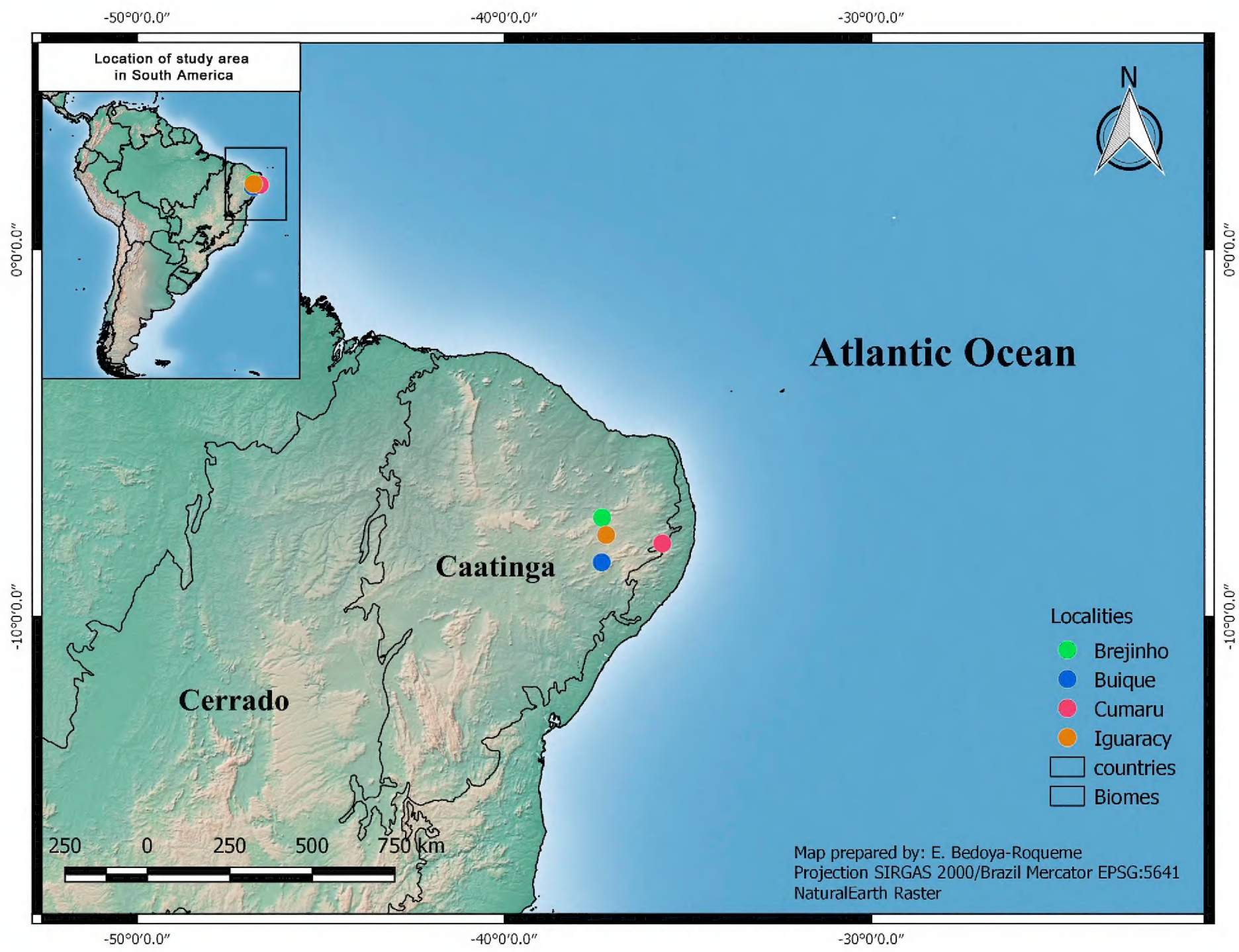

Figure 1. Location of the study area in Caatinga biome, Brazil.

adapted to drought conditions (Silva et al. 2004).

Pseudoscorpions were collected in both dry and wet seasons by two sampling methods following Gabbutt (1970) and Mahnert and Adis (2002), which included mini-Winkler extractors and active manual search. For the first method, a mini-Winkler leaf litter extractor system was constructed. The mini-Winkler extractors consisted of a frame of PVC pipes (50 cm × 2 cm) and nylon mesh in a 50 cm × 50 cm. These were arranged on the surface of the soil at the collection site. All the organic material in the immediate vicinity was collected until the soil was totally exposed and sieved through the Winkler extractors to collect leaf-litter dwelling arthropods. For the second method, we carefully checked all microhabitats (e.g. under stones, fallen logs, under bark of trees) at a site that were potentially used by pseudoscorpions, using a thin brush to collect the individuals. Four researchers sampled simultaneously over two consecutive days in both seasons at each site for 1 h in the morning (8:00–9:00 am), for a total of 4 h of sampling per day. We performed one sampling per researcher per day. Geographical coordinates were obtained using a Garmin hand-held GPS receiver. The Caatinga biome comprises tropical vegetation rich in succulent plants and poor in grasses, not adapted to the regular occurrence of natural fire that occurs in regions with fertile soil and bimodal precipitation (Fernandes and Queiroz 2018).

For each specimen one leg I, one leg IV, one chelicera, and one pedipalp were dissected. The dissected pedipalp chela had its chela fingers separated. Subsequently, specimens were cleared by slow diffusion in 70% lactic acid (ca 30 min at 23 °C, except for the specimens of Chernetidae, which were maintained in slow diffusion for 24 h). Genital organs immersed in lactic acid for a few hours or longer and observed. If necessary, these organs were also cleared in 10% KOH solution (ca 30 min at 23 °C). The specimens were studied using temporary slide-mounts in a glycerin medium using a Leica DM500 stereomicroscope. Taxonomic characters were measured using ImageJ v. 1.8.0.

After examination all specimens were preserved in 70% EtOH, with the dissected portions in a microvial in the same vial as the rest of each specimen. Some specimens were photographed with an HD digital camera attached to the stereomicroscope; multiple images at different focal lengths were taken and stacked into a composite image using AxioVision Carl Zeiss (Rel.4.8.2. SP3) by E. Bedoya-Roqueme. For the identification of specimens, we used the keys to families and genera (Harvey 1992; Mahnert and Adis 2002; Buddle 2010) and descriptions by Mahnert (1979) for *Geogarypus* Chamberlin 1930; Hoff (1945), Mahnert (1985b), and Mahnert and Adis (1986) for *Apolpium* Chamberlin 1930; Balzan (1892), Beier (1932, 1954), Feio (1945), and Tooren (2002, 2011) for *Pachyolpium* Beier 1931; and Beier (1970), Mahnert (1985b), the comments made by Turk (1953), and Bedoya-Roqueme (2019) for *Sphenochernes* Turk, 1953. Terminology and mensuration mostly follow Chamberlin (1931), except for the nomenclature of the pedipalps and legs, and with some minor modifications to the terminology of the trichobothria (Harvey 1992), chelicera (Harvey and Edward 2007; Judson 2007), and the faces of appendages (Harvey et al. 2012). The ratios are length/width for carapace, chelicera, and pedipalps, and length/depth for legs; when two articles are compared the ratio is length/length index. The measurements are expressed in millimeters (mm). The specimens identified were deposited in the collection of the Arachnid Behavioral Ecology Laboratory, State University of Goiás, Anápolis, Brazil.

We mainly follow the taxonomic proposals by Benavides et al. (2019) which relegated the families Tridenchthoniidae and Lechytiidae to Chthoniidae as subfamilies, and the family Garypinidae with the Larcidae in the superfamily Garypinoidea. Despite presenting some inconsistencies with the taxonomic arrangement proposed by Tooren van den (2011), with *Apolpium* Chamberlin, 1930 as a member of Olpiinae, molecular results support the placement of this genus together with *Pachyolpium* Beier, 1931 in Hesperolpiinae. We accept the elevation of the family Hesperolpiidae Chamberlin, 1930 as a group sister of the families Garypidae and Olpiidae. The main difference being the short venom ducts of Olpiidae (except *Pachyolpium irmgardae,* Mahnert 1979 have short venom ducts that in the fixed finger do not extend to *et* (Mahnert 1979), and *Pachyolpium brevipes* (With 1906). The venom duct of the fixed finger only extends to *et* (Heurtault and Rebière 1983), which rarely extend beyond trichobothrium *et*, and the long venom ducts of Hesperolpiidae, which are generally extremely long (Benavides et al. 2019).

The occurrence and richness data were obtained through the standard literature, through online databases, such as Web of Science (http://www.clarivate.com/products/web-of-science), BioOne (http://www.bioone.org), Jstor (http://www.jstor.org), Google academics (https://www.scholar.google.com.br), using the keywords: "Pseudoscorpiones", "Brazil", "Distribution", "Arachnida" in the languages English, Spanish, and Portuguese. Additionally, The Pseudoscorpions of the World, version 3.0 (Harvey 2013) and the Global Biodiversity Information Facility-GBIF (https://www.gbif.org) were used. Maps were prepared using QGIS v. 3.4.12 (QGIS Development Team 2018). Occurrence data of all species known from Brazil were gathered from the literature and added to our data set (Harvey 2013). These data were then interpolated onto the map using the IDW protocol (Wise 2000).

Results

We compiled records of 174 pseudoscorpion species in Brazil, among them nine records were from Caatinga biome (Table 1). In total, we collected 47 pseudoscorpions, including three individuals (2♀, 1 nymph) of *Geogarypus amazonicus* Mahnert 1979, 38 individuals (16♂;

Table 1. Checklist of species and distribution patterns of pseudoscorpions in Brazil. Abbreviations of biomes: Amazônia = Ama. Caatinga = Caa. Cerrado = Cerr. Mata Atlântica = MA. Pantanal = Pn. Pampa = Pa. State Abbreviations: Acre = AC, Alagoas = AL, Amapá = AP, Amazonas = AM, Bahia = BA, Ceara = CE, Distrito Federal = DF, Espirito Santo = ES, Goiás = GO, Maranhão = MA, Mato Grosso = MT, Mato Grosso do Sul = MS, Minas Gerais = MG, Para = PA, Paraíba = PB, Paraná = PR, Pernambuco = PE, Piauí = PI, Rio de Janeiro = RJ, Rio Grande do Norte = RN, Rio Grande do Sul = RS, Rondônia = RO, Roraima = RR, Santa Catarina = SC, São Paulo = SP, Sergipe = SE, Tocantins = TO. An asterisk following the species name indicates a new distribution record.

Taxon	Biome	Geographical region	State	Reference(s)
Family Atemnidae				
Brazilatemnus browni Muchmore, 1975	Ama	N	AM	Muchmore 1975; Mahnert 1979; Harvey 2013
Caecatemnus setosipygus Mahnert, 1985	Ama	N	AM	Mahnert 1985b; Harvey 2013
Paratemnoides minutissimus (Beier, 1974)	MA	S	PR	Harvey 2013
Paratemnoides nidificator (Balzan, 1888)	Ama, MA, Cerr	NE, N, Mid, SE	AM, BA, DF, MT, PA, PR, RR, SP	Harvey 2013
Family Bochicidae				
Spelaeobochica allodentatus Mahnert, 2001	MA	NE	BA	Mahnert 2001; Harvey 2013
Spelaeobochica goliath Viana et al., 2018	MA	SE	MG	Viana et al. 2018
Spelaeobochica iuiu Ratton et al., 2012	MA	NE	BA	Ratton et al. 2012
Spelaeobochica mahnerti Viana & Ferreira, 2020	MA	SE	MG	Viana and Ferreira 2020
Spelaeobochica muchmorei Andrade & Mahnert, 2003	MA	SE	SP	Harvey 2013
Family Cheiridiidae				
Cheiridium brasiliense Mahnert, 2001	Cerr	NE	PI	Mahnert 2001; Harvey 2013
Cheiridium itapemirinense (Feio, 1941)	MA	SE	ES	Feio 1941; Harvey 2013
Neocheiridium corticum (Balzan, 1887)	Ama	N	AM	Mahnert and Adis 2002; Harvey 2013
Neocheiridium triangulare Mahnert & Aguiar, 1986	Ama	N	AM	Mahnert and Aguiar 1986; Harvey 2013
Family Cheliferidae				
Chelifer cancroides (Linnaeus, 1758)	MA	S	SC	Harvey 2013, 2014
Lophodactylus rex (With, 1908)	Ama	N	AM	Harvey 2013
Parachelifer lativittatus (Chamberlin, 1923)	Ama	N	AM	Mahnert and Adis 2002; Harvey 2013
Tyrannochelifer imperator (With, 1908)	Cerr	Mid	MT	With 1908; Harvey 2013
Family Chernetidae				
Americhernes bethaniae Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Americhernes eidmanni (Beier, 1935)	MA	SE	RJ	Harvey 2013
Americhernes incertus Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Americhernes plaumanni (Beier, 1974)	MA	S	SC	Mahnert 1979; Harvey 2013
Americhernes suraiurana (Feio, 1945)	MA	NE	BA	Feio 1941; Harvey 2013
Anaperochernes margaritifer Mahnert, 1985	Ama	N	AM	Harvey 2013
Attaleachernes thaleri Mahnert, 2009	Cerr	Mid	MT	Mahnert 2009; Harvey 2013
Ceriochernes amazonicus Mahnert, 1985	Ama	N	AM	Mahnert and Adis 2002; Harvey 2013
Ceriochernes brasiliensis Beier, 1974	MA	S	SC	Harvey 2013
Ceriochernes foliaceosetosus Beier, 1974	MA	S	SC	Harvey 2013
Cordylochernes scorpioides (Linnaeus, 1758)	Ama, Caa, MA, Cerr	NE, N, SE, Mid, S	AM, BA, ES, MA, MG, PA, RJ, SC, SP	Harvey 2013
Corosoma sellowi Karsch, 1879	MA	SE	SP	Harvey 2013
Gigantochernes rudis (Balzan, 1887)	MA	NE	BA	Harvey 2013
Gomphochernes communis (Balzan, 1888)	Cerr	Mid	MT	Harvey 2013
Lamprochernes savignyi (Simon, 1881)	—	—	—	Harvey 2013
Lustrochernes argentinus (Thorell, 1877)	Cerr	Mid	MT	Harvey 2013
Lustrochernes brasiliensis (Daday, 1889)	—	—	—	Harvey 2013
Lustrochernes intermedius (Balzan, 1892)	Ama	N	AM	Mahnert and Adis 2002; Harvey 2013
Lustrochernes ovatus (Balzan, 1892)	MA	SE	MG	Harvey 2013
Lustrochernes reimoseri Beier, 1932	—	—	—	Harvey 2013
Lustrochernes rufimanus (C.L. Koch, 1843)	—	—	—	Harvey 2013
Lustrochernes similis (Balzan, 1892)	Ama	N	AM	Mahnert 1979; Harvey 2013
Lustrochernes subovatus (With, 1908)	—	—	—	Harvey 2013
Maxchernes iporangae Mahnert & Andrade, 1998	MA	SE	SP	Mahnert and Andrade 1998; Harvey 2013
Maxchernes plaumanni Beier, 1974	MA	S	SC	Harvey 2013
Odontochernes cervus (Balzan, 1888)	Cerr	Mid	MT	Beier 1932; Harvey 2013
Pachychernes baileyi Feio, 1945	MA	NE	BA	Feio 1941; Harvey 2013
Pachychernes robustus (Balzan, 1888)	Cerr	Mid	MT	Harvey 2013
Parachernes (*Parachernes*) *adisi* Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Parachernes (*Parachernes*) *albomaculatus* (Balzan, 1892)	Ama	N	AM	Aguiar and Bührnheim 1998; Harvey 2013
Parachernes (*Parachernes*) *argentatopunctatus* (Ellingsen, 1910)	Cerr	Mid	MT	Harvey 2013
Parachernes (*Parachernes*) *confraternus* (Banks, 1909)	Cerr	Mid	MT	Harvey 2013
Parachernes (*Parachernes*) *crassimanus* (Balzan, 1887)	Cerr	Mid	MT	Harvey 2013

Taxon	Biome	Geographical region	State	Reference(s)
Parachernes (*Parachernes*) *inpai* Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Parachernes (*Parachernes*) *meinertii* (With, 1908)	Ama	N	AM	Mahnert 1979; Harvey 2013
Parachernes (*Parachernes*) *melanopygus* Beier, 1959	Ama	N	AM	Harvey 2013
Parachernes (*Parachernes*) *nitidimanus* (Ellingsen, 1905)	Ama	N	PA	Harvey 2013
Parachernes (*Parachernes*) *ovatus* Mahnert, 1979	Ama	N	AM	Harvey 2013
Parachernes (*Parachernes*) *plumosus* (With, 1908)	Ama	N	AM	Mahnert and Adis 2002; Harvey 2013
Parachernes (*Parachernes*) *pulcher* Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Parachernes (*Parachernes*) *ronnaii* Chamberlin, 1931	Pa	S	MS	Harvey 2013
Parachernes (*Parachernes*) *setiger* Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Parachernes (*Parachernes*) *withi* Beier, 1967	MA	SE	RJ	Harvey 2013
Petterchernes brasiliensis Heurtault, 1986	Caa	NE	PE	Harvey 2013
Petterchernes tuberculatus Mahnert, 1994	Ama	N	MA	Harvey 2013
Phymatochernes crassimanus Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Pseudopilanus crassifemoratus Mahnert, 1985	Ama	N	AM	Mahnert 1985; Harvey 2013
Pseudopilanus echinatus (Ellingsen, 1904)	—	—	—	Harvey 2013
Pseudopilanus foliosus (Balzan, 1887)	—	—	—	Harvey 2013
Rhopalochernes germainii (Balzan, 1887)	Cerr	Mid	MT	Harvey 2013
Rhopalochernes ohausi (Tullgren, 1907)	MA	SE	RJ	Harvey 2013
Semeiochernes armiger (Balzan, 1892)	Ama	N	PA	Mahnert and Adis 2002; Harvey 2013
Semeiochernes militaris Beier, 1932	Ama	N	AM	Harvey 2013
Spelaeochernes altamirae Mahnert, 2001	Ama	N	PA	Mahnert 2001; Harvey 2013
Spelaeochernes armatus Mahnert, 2001	MA	S	SC	Mahnert 2001; Harvey 2013
Spelaeochernes bahiensis Mahnert, 2001	MA	NE	BA	Mahnert 2001; Harvey 2013
Spelaeochernes dentatus Mahnert, 2001	MA	S	PR	Mahnert 2001; Harvey 2013
Spelaeochernes dubius Mahnert, 2001	MA	SE	SP	Mahnert 2001; Harvey 2013
Spelaeochernes eleonorae Mahnert, 2001	MA	SE	SP	Mahnert 2001; Harvey 2013
Spelaeochernes gracilipalpus Mahnert, 2001	MA	SE	SP	Mahnert 2001; Harvey 2013
Spelaeochernes pedroi Mahnert, 2001	MA	NE	BA	Mahnert 2001; Harvey 2013
Spelaeochernes popeye von Schimonsky & Bichuette, 2019	Caa, MA	NE	BA, SE	von Schimonsky and Bichuette 2019
Sphenochernes camponoti (Beier, 1970)*	Caa, MA	SE, NE	SP, PE	Harvey 2013; This study
Sundochernes brasiliensis Beier, 1974	MA	S	SC	Harvey 2013
Xenochernes caxinguba Feio, 1945	MA	SE	MG	Feio 1941; Harvey 2013
Zaona cavicola Mahnert, 2001	Cerr	Mid	MS	Mahnert 2001; Harvey 2013
Family Chthoniidae				
Subfamily Chthoniinae				
Austrochthonius argentinae Hoff, 1950	—	—	—	Harvey 2013
Austrochthonius bolivianus Beier, 1930	—	—	—	Harvey 2013
Austrochthonius iguazuensis Vitali-di Castri, 1975	MA	S	PR	Harvey 2013
Austrochthonius semiserratus Beier, 1930	—	—	—	Harvey 2013
Lagynochthonius irmleri (Mahnert, 1979)	Ama	N	AM	Mahnert 1979; Harvey 2013
Lagynochthonius minor (Mahnert, 1979)	Ama	N	AM	Mahnert 1979; Harvey 2013
Pseudochthonius biseriatus Mahnert, 2001	MA	SE	MG	Mahnert 2001; Harvey 2013
Pseudochthonius brasiliensis Beier, 1970	MA	SE	SP	Harvey 2013
Pseudochthonius gracilimanus Mahnert, 2001	MA	NE	BA	Mahnert 2001; Harvey 2013
Pseudochthonius heterodentatus Hoff, 1946	—	—	—	Harvey 2013
Pseudochthonius homodentatus Chamberlin, 1929	—	—		Harvey 2013
Pseudochthonius orthodactylus Muchmore, 1970	Ama	N	PA	Mahnert 1979; Harvey 2013
Pseudochthonius ricardoi Mahnert, 2001	MA	SE	SP	Mahnert 2001; Harvey 2013
Pseudochthonius strinatii Beier, 1969	MA	SE	SP	Harvey 2013
Pseudochthonius tuxeni Mahnert, 1979	Ama	N	PA	Mahnert 1979; Harvey 2013
Tyrannochthonius amazonicus Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Tyrannochthonius brasiliensis Mahnert, 1979	Ama	N	PA	Mahnert 1979; Harvey 2013
Tyrannochthonius migrans Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Tyrannochthonius rotundimanus Mahnert, 1985	Ama	N	AM	Harvey 2013
Subfamily Lechytiinae				
Lechytia chthoniiformis (Balzan, 1887)			AM, MS, RR	Harvey 2013
Subfamily Tridenchthoniinae				
Cryptoditha elegans (Beier, 1931)	MA	SE	MG	Mahnert 2001; Harvey 2013
Compsaditha fiebrigi (Beier, 1931)	MA	SE	RJ	Feio 1945; Harvey 2013
Cryptoditha francisi (Feio, 1945)	MA	SE	RJ	Harvey 2013
Heterolophus guttiger Tömösváry, 1884	MA	SE	SP	Harvey 2013
Heterolophus nitens Tömösváry, 1884	MA	SE	SP	Harvey 2013

Taxon	Biome	Geographical region	State	Reference(s)
Neoditha irusanga Feio, 1945	MA	SE	RJ	Feio 1945; Harvey 2013
Sororoditha hirsuta (Balzan, 1887)	Cerr	Mid	MT	Harvey 2013
Tridenchthonius brasiliensis Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Tridenchthonius mexicanus Chamberlin and R.V. Chamberlin, 1945	Ama	N	PA	Mahnert and Adis 2002; Harvey 2013
Family Feaeliidae				
Iporangella orchama Harvey, Andrade & Pinto-da-Rocha, 2016	MA	SE	SP	Harvey et al. 2016
Family Garypinidae				
Amblyolpium ortonedae (Ellingsen, 1902)	Cerr	Mid	DF	Feio 1945; Harvey 2013
Family Geogarypidae				
Geogarypus amazonicus Mahnert, 1979*	Ama, Caa	N, NE	AM, PE	Mahnert 1979; Harvey 2013; This study
Geogarypus cuyabanus (Balzan, 1887)	Cerr	Mid	MT	Harvey 2013
Geogarypus formosus (Mello-Leitão, 1937)	MA	SE	RJ	Harvey 2013
Geogarypus paraguayanus Beier, 1931	Cerr	Mid	DF	Feio 1945; Harvey 2013
Family Hesperolpiidae				
Apolpium ecuadorense Hoff, 1945*	Ama, Caa	N, NE	AM, PE	Mahnert and Adis 2002; Harvey 2013; this study
Apolpium minutum Beier, 1931	—	—	—	Harvey 2013
Pachyolpium erratum Beier, 1931	MA	SE	RJ	Harvey 2013
Pachyolpium furculiferum (Balzan, 1892)*	Caa	NE	PE	Feio 1945; Harvey 2013
Pachyolpium crassichelatum (Balzan, 1887)	Cerr	Mid	MS	Harvey 2013
Pachyolpium irmgardae Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Progarypus gracilis Mahnert, 2001	MA	SE	MG	Mahnert 2001; Harvey 2013
Progarypus liliae Mahnert, 2001	MA	NE	BA	Mahnert 2001; Harvey 2013
Progarypus nigrimanus Mahnert, 2001	MA	SE	SP	Mahnert 2001; Harvey 2013.
Progarypus novus Beier, 1931	—	—	—	Harvey 2013
Progarypus setifer Mahnert, 2001	MA	SE	MG	Harvey 2013
Family Ideoroncidae				
Ideoroncus anophthalmus Mahnert, 1984	MA	SE	SP	Mahnert 1984; Harvey 2013
Ideoroncus beieri Mahnert, 1984	MA	S	PR	Mahnert 1984; Harvey 2013
Ideoroncus cavicola Mahnert, 2001	MA	SE	SP	Mahnert 2001; Harvey 2013
Ideoroncus divisus Mahnert, 1984	Pa	S	RS	Mahnert 1984; Harvey 2013
Ideoroncus lenkoi Beier, 1970	MA	SE	SP	Harvey 2013
Ideoroncus paranensis Mahnert, 1984	MA	S	PR	Mahnert 1984; Harvey 2013
Ideoroncus procerus Beier, 1974	MA	S	SC	Harvey 2013
Ideoroncus setosus Mahnert, 1984	MA	SE	SP	Mahnert 1984; Harvey 2013
Xorilbia arboricola (Mahnert, 1979)	Ama	N	AM	Mahnert 1979; Harvey 2013
Xorilbia gracilis (Mahnert, 1985)	Ama	N	AM	Harvey 2013
Xorilbia lamellifer (Mahnert, 1985)	Ama	N	AM	Harvey 2013
Family Olpiidae				
Banksolpium magnum Muchmore, 1986	MA	SE	MG	Harvey 2013
Banksolpium modestum (Banks, 1909)	Caa	NE	PE	Harvey 2013
Olpiolum elegans (Balzan, 1887)	MA	NE	BA	Feio 1945; Harvey 2013
Family Pseudochiridiidae				
Pseudochiridium aff. *insulae* Hoff, 1964	Caa	NE	BA	von Schimonsky et al. 2014
Family Syarinidae				
Ideobisium peckorum Muchmore, 1982	Ama	N	AM	Mahnert and Adis 2002; Harvey 2013
Ideobisium schusteri Mahnert, 1985	Ama	N	AM	Mahnert 1985; Harvey 2013
Ideoblothrus amazonicus (Mahnert, 1979)	Ama	N	AM	Mahnert 1979; Harvey 2013
Ideoblothrus brasiliensis (Mahnert, 1979)	Ama	N	PA	Mahnert 1979; Harvey 2013
Ideoblothrus caecus (Mahnert, 1979)	Ama	N	PA	Mahnert 1979; Harvey 2013
Ideoblothrus levipalpus Mahnert, 1985	Ama	N	AM	Harvey 2013
Ideoblothrus paraensis Mahnert, 1985	Ama	N	PA	Mahnert 1985; Harvey 2013
Ideoblothrus tenuis Mahnert, 1985	Ama	N	AM	Mahnert 1985; Harvey 2013
Microblothrus tridens Mahnert, 1985	Ama	N	AM	Mahnert and Adis 2002; Harvey 2013
Nannobisium beieri Mahnert, 1979	Ama	N	PA	Mahnert 1979; Harvey 2013
Family Withiidae				
Balanowithius weyrauchi Beier, 1959	—	—	—	Harvey 2013
Cacodemonius segmentidentatus (Balzan, 1887)	Cerr	Mid	MT	Harvey 2013
Dolichowithius (*Dolichowithius*) *brasiliensis* (Beier, 1930)	Pa	S	RS	Harvey 2013
Dolichowithius (*Dolichowithius*) *canestrinii* (Balzan, 1887)	MA	NE	BA	Feio 1945; Harvey 2013
Dolichowithius (*Dolichowithius*) *emigrans* (Tullgren, 1907)	Ama	N	AM	Harvey 2013
Dolichowithius (*Dolichowithius*) *intermedius* Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Dolichowithius (*Dolichowithius*) *longichelifer* (Balzan, 1887)	Cerr	Mid	MT	Feio 1945; Harvey 2013

Taxon	Biome	Geographical region	State	Reference(s)
Dolichowithius (*Dolichowithius*) *mediofasciatus* Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Dolichowithius (*Dolichowithius*) *minutus* Mahnert, 1979	Ama	N	AM	Mahnert 1979; Harvey 2013
Neowithius dubius Beier, 1932	MA	S	SC	Beier 1932; Harvey 2013
Victorwithius coniger (Mahnert, 1979)	Ama	N	AM	Mahnert 1979; Harvey 2013
Victorwithius gracilimanus (Mahnert, 1979)	Ama	N	AM	Harvey 2013
Victorwithius mimulus (Beier, 1954)	MA	S	PR	Harvey 2013
Victorwithius monoplacophorus Feio, 1944	MA	S	PR	Harvey 2013
Victorwithius rufus (Balzan, 1887)	Cerr	Mid	MT	Harvey 2013
Victorwithius venezuelanus (Beier, 1932)	MA	SE	SP	Feio 1945; Harvey 2013
Withius piger (Simon, 1878)	—	—	—	Harvey 2013

22♀) of *Apolpium ecuadorense* Hoff 1945, one individual (1♂) of *Pachyolpium furculiferum* (Balzan 1892), and six individuals (4♂; 2♀) of *Sphenochernes camponoti* (Beier 1970). The collected species and new records of pseudoscorpions in this study are listed and described as follows:

Family Geogarypidae Chamberlin 1980

Geogarypus amazonicus Mahnert 1979

New records. BRAZIL, Pernambuco, Iguaracy municipality, Monte Alegre village, 07°46′27.4″S, 037°13′36.2″W, around 550 m a.s.l., August 2012, Arboreal Caatinga, Aluisio Sales Ribeiro leg. (LECA; SCR–002). Figs 1, 2A, B.

Identification. According to the description by Mahnert (1979), *G. amazonicus* can be easily distinguished from other species of the genus by the granulated carapace and tergites, with a long cucullus, somewhat variable color edges of the carapace, with a indistinct transverse furrows, anterior margin of the carapace with four setae, posterior margin with 18 setae (Fig. 2A, B). Chelicerae with five setae on the hand, fixed finger with three or four teeth, movable finger with two or three small teeth, a simple cone-shaped galea with some branches, exterior serrula with 16 blades, rallum with a blade. Anterior operculum of the female with 14 setae, genital chamber with 2 + 2 setae, side bags strongly folded, medium-short and slightly folded bags at the end, with a cribate plate with multiple pores. Pedipalps dense and thick granules, without prolateral roughness but irregular and granulated chelal fingers in the basal half, femur 3.1× longer than wide, patella 2.5× longer than wide, hand with pedicel, chelate with pedicel 3.5× (Fig. 2A, B), fixed finger with 48 teeth, fixed finger with 48 teeth, of which 1 or 2 are small distal and the teeth are arranged in a double row in the distal half, nodus ramosus, proximal, mobile finger with 27 teeth, which point only in the distal half, trichobothrium *st* somewhat variable in position, almost

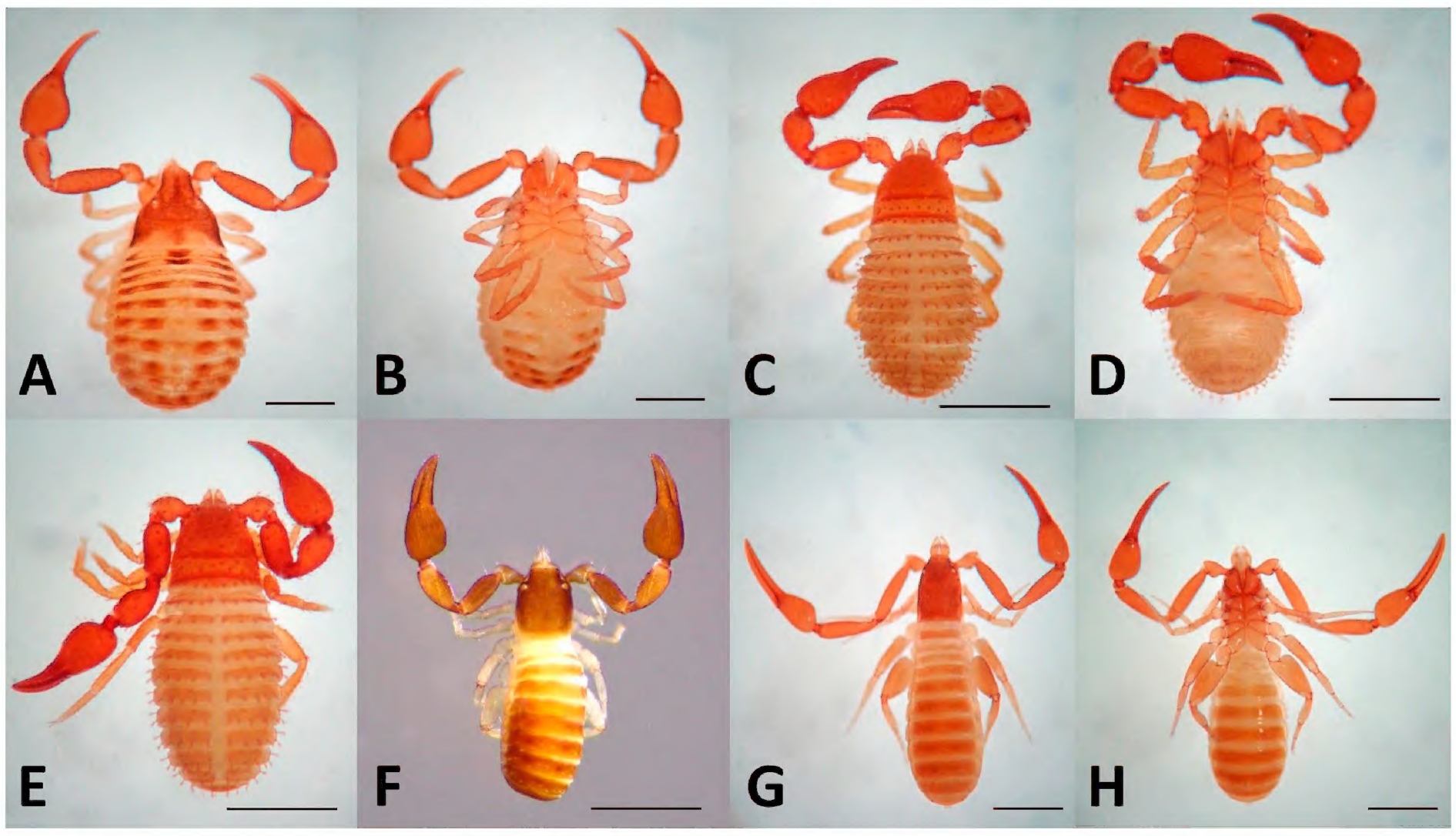

Figure 2. Habitus. Pseudoscorpions from Caatinga. **A, B.** *Geogarypus amazonicus*: (**A**) dorsal view (**B**) ventral view. **C–E.** *Sphenochernes camponoti*: (**C**) dorsal view, male; (**D**) ventral view, male; (**E**) dorsal view, female. **F.** *Pachyolpium furculiferum*, dorsal view, male. **G, H.** *Apolpium ecuadorense*, female: (**G**) dorsal view; (**H)** ventral view. All scale bars = 0.5 mm.

midway, between *sb* and *t* (e.g. Mahnert, 1979; fig. 88b). Leg I: femur 2.2× longer than wide, patella 1.5×, tibia 2.2×, tarsal 2.1×, metatarsal 2.6×. Leg IV: femur + patella 5.6×, tibia 2.8×, tarsus 2.8×, arolia larger than claws.

Measurements (mm). Female, body length 1.65, carapace 0.62/0.73; pedipalps: femur 0.53/0.15, patella 0.41/0.18, hand with pedicel 0.45/0.28, chela with pedicel 0.91/0.28, length mobile finger 0.5; leg I: femur 0.23/0.10, patella 0.39/0.10, tibia 0.18/0.08, tarsal I: 0.13/0.06, tarsal II: 0.11/0.06; Leg IV: femur + patella: 0.79/0.14, tarsal I: 0.17/0.06, tarsal II: 0.13/0.04.

Remarks. Measurements and ratios of pedipalps and some other taxonomic characters, correspond to the description of *G. amazonicus* from Brazil (Mahnert 1979: figs 80–90), but our Caatinga specimen is slightly different from the other Brazilian specimens in the length of the patella I (0.39 mm vs 0.17 mm in a Manaus specimen) and without presenting variations in the distribution of the trichobothrium. However, these differences can be attributed to intraspecific variation over the geographical distribution of the species, as all the diagnostic characters correspond to *G. amazonicus*.

Comments. We collected *G. amazonicus* in well-preserved arboreal Caatinga remnants near river springs.

Geographical distribution. Brazil (Table 1).

Hesperolpiidae Chamberlin 1930

***Apolpium ecuadorense* Hoff 1945**

New records. BRAZIL, Pernambuco, Cumaru municipality, Ameixas village, 08°00′21″S, 035°41′49″W, ca 440 m a.s.l., January 2015, shrub Caatinga, André F.A. Lira leg. (LECA; SCR-003A). Catimbau valley, Buíque municipality, 08°30′57″S, 037°20′59″W, around 810 m a.s.l., January 2015, shrub Caatinga, André F.A. Lira leg. (LECA; SCR-003B). Brejinho village, Brejinho municipality, 07°18′11″S, 037°20′10″W, ca 740 m a.s.l., shrub Caatinga, Aluisio Sales Ribeiro leg. (Laboratory ARREÁgua, BRE-J-A1). Monte Alegre village, Iguaracy municipality, 07°46′27.4″S, 037°13′36.2″W, 558 m a.s.l., August 2012, Arboreal Caatinga, Aluísio Sales Ribeiro leg. (LECA; SCR-003C). Fig. 2G, H.

Identification. According to the description by Hoff (1945), Mahnert (1985b), Mahnert and Adis (1986), this species can be easily distinguished from congeners by the following combination of characters: robust body; pedipalps moderately thinned, except the hand quelal; all setae are relatively long and accumulated; yellowish brown body color, with palps, carapace and somewhat darker tergites; posterior margin almost straight with apparently four marginal setae placed somewhat anterior to the actual margin; area between setae and margin smooth and unpigmented; lateral surfaces and the posterior margin just anterior to the marginal setae marked by net-like lines; surface of carapace with about 10 acuminate setae and a few slit-like lyrifissures; eyes of the two pairs large, almost circular in outline. Chelicerae with five sensory setae, *b* and *sb* shorter than others, all acuminate; rallum with three blade, the two proximal ones subequal in length and much shorter than the third, the longest seta finely serrate, at least distally along the anterior margin, the other two setae appear smooth; fixed finger with well-developed blade-like exterior; apical tooth short, somewhat blunt; apical tooth with two shallow, conical teeth on inner surface; inner margin of finger with five retroconical teeth. Movable finger slender, subapical lobe conical and placed near base of apical tooth at same level as insertion of galeal seta and galea; galeal seta shorter than the galea; galea relatively slender and straight, trifid in the distal one-fifth with branches simple, serrula exterior of about 23 blades. Anterior operculum with four very slender setae on each side; posterior operculum relatively little modified and with a row of six marginal setae, with a plate cribate include a pair of prominent lateral plates and two median pairs; pedipalps moderately slender except chelal hand; golden brown color, polished, smooth, trochanter subtriangular; inner margin well rounded, outer margin short and weakly concave; femur 3.8×, with pedicle barely indicated; outer margin almost straight except for a sinuation at the region of the pedicle and a distal convexity; a dorsal sensory seta in the basal third; patella 3.03× with inner margin centrally bulging, a concavity in the region of the pedicle; Chela 3.17×; nodus ramosus of movable finger somewhat distal of *t*, and on fixed finger about midway between trichobothrium *et* and the level of *it*; distribution of trichobothrium (Hoff 1945; fig. 10); legs slender; smooth; light yellow in color; setae long and acuminate, Leg I with trochanter subtriangular 3.5×; femur 1.9×; patella 4.2×; tibia 4.3×; metatarsus 4.5×; tarsus 3.61;claws small and simple, arolium extending much beyond the claws and distally widened; leg IV, trochanter virtually straight 1.6×, femur+patella 2.57×; tibia 4.3×; metatarsus 3.9×; tarsus 4.8×; claws and arolium as in the first leg.

Measurements (mm). Measurements of female in parenthesis, carapace 0.70–0.73/0.49–0.50 (0.73–0.74/0.57–0.60); pedipalps: femur 0.70–0.73/0.19–0.22 (0.77–0.79/0.20–0.21), patella 0.63–0.66/0.21–0.22 (0.71–0.73/0.23–0.27), hand with pedicel 0.57–0.61/0.34–0.37 (0.70–0.71/0.42–0.44), chela with pedicel 1.18–1.23 (1.30–1.35), length movable finger 0.62–0.67 (0.67–0.72). Leg I: femur 0.36–0.37/0.11–0.12 (0.37–0.43/0.10–0.12), patella 0.16–0.18/0.10–0.11 (0.21–0.22/0.10–0.11), tibia 0.23–0.24/0.07 –0.09 (0.24–0.26/0.07–0.08), metatarsus 0.21–0.22/0.05–0.06 (0.23–0.24/0.06–0.07), tarsus 0.19–0.20/0.04–0.05 (0.18–0.20/0.04–0.05), leg V: femur+patella 0.63–0.67/.25–0.27 (0.71–0.72/0.25–0.26), tibia 0.41–0.44 /0.09–0.10 (0.45–0.47/0.10–0.11), metatarsus 0.28–0.29/0.07–0.08 (0.30–0.31/0.05–0.07), tarsus 0.20–0.22/0.04 –0.05 (0.21–0.23/0.05–0.06).

Remarks. Measurements and ratios of pedipalps, granules of the carapacal mesozone, and some other taxonomic characters correspond with the description of *A. ecuadorense* from Brazil and Ecuador (Hoff 1945: 7–10,

figs 8–10). The specimen from the Caatinga is slightly different from the female holotype of *A. ecuadorense* in that the length of the femur pedipalpal is shorter 0.70–0.73 (0.77–0.79) mm (vs 0.85 mm in the Ecuador specimen). These differences can be attributed to intraspecific variations by the geographical distribution of the species, as all the diagnostic characters correspond to *A. ecuadorense*.

Geographical distribution. Ecuador, Brazil (Table 1).

Pachyolpium furculiferum (Balzan 1892)

New records. BRAZIL, Pernambuco, Iguaracy municipality, Monte Alegre village, 07°46′27.4″S, 037°13′ 36.2″W, ca 550 m a.s.l., August 2012, Arboreal Caatinga, Aluisio Sales Ribeiro leg. (LECA, SCR-004). Fig. 1.

Identification. This species can be distinguished from its congeners by the following characters (Balzan 1892; Beier 1932, 1954; Feio 1945; Tooren 2002): carapace longer than wide and without transverse furrows; red brown coloration, with chela pedipalpal orange-red, patella brownish red. Basal segments of pedipalps and tergites light yellowish-brown, and legs and chelicerae very pale reddish-yellow. Carapace with two pairs of well-developed eyes; anterior margin of carapace with two medial setae; each side with two lateral setae; posterior margin with four setae. Chelicerae with five setae on hand; galea with main stalk terminally bifid, with small lateral ramus arising on about distal fifth. Movable finger with sharp conical subapical lobe; serrula exterior with 23 blades; rallum with three blades spiny, inner margin of fixed finger with three sclerotic and four very flat retroconical teeth. Male genital area, anterior operculum with 14 along anterior setae on; two pairs of medial setae along posterior margin of posterior lip; with nine setae on posterior operculum. Pedipalp: trochanter 1.78×; femur 2.77×; patella 2.67×, chela with pedicel 2.75×; hand with pedicel 1.53×, length movable finger 0.55. Legs: Leg I trochanter 1.21×; femur 2.77×; patella 1.75; tibia 3.43×; metatarsus 3.14; tarsus 3.45×; undivided arolia larger than claws; leg IV: trochanter 1.77×; femur + patella 2.26×; tibia 3.56×; metatarsus 3.13×; tarsus 3.82×; undivided arolia larger than claws.

Measurements (mm). Body length 2.3; carapace 0.72/ 0.52. Pedipalps: femur 0.63/0.19, patella 0.71/0.27, hand with pedicel 0.68/0.43, chela with pedicel 1.02/0.37, length movable finger 0.54. Leg I: femur 0.27/0.10, patella 0.17/0.10, tibia 0.25/0.07, metatarsus 0.23/ 0.07, tarsus 0.20/0.05, leg V: femur+patella 0.62/0.28, tibia 0.45/0.12, metatarsus 0.23/0.08, tarsus 0.20/0.05.

Remarks. Measurements and ratios of pedipalps, and some other taxonomic characters, correspond to the description of *P. furculiferum* (Balzan 1892: figs 30, 30a, b). The specimen of Caatinga is slightly different in the length of the patella pedipalpal 0.71, these differences can be attributed to intraspecific variations by the geographical distribution of the species, since all the diagnostic characters according to Tooren (2002) correspond to the species *P. furculiferum*.

Geographical distribution. Brazil, Cayman Islands, Saint Vincent and the Grenadines, U.S. Virgin Islands, Venezuela (Tooren 2002; Harvey 2013).

Comments. The species were collected under stones and in decaying trees in a peri-urban area of Caatinga vegetation.

Chernetidae Menge 1855

Sphenochernes camponoti (Beier 1970)

New records. Brazil, Pernambuco, Buíque municipality, Catimbau valley, 08°30′57″S, 037°20′59″W, ca 810 m a.s.l., shrub Caatinga, January 2015, Rodrigo Carmo leg. (LECA; SCR-005). Figs 1, 2C–F

Identification. According to the descriptions by Beier (1970) and subsequent authors (Mahnert 1985b; Turk 1953), *S. camponoti* (Beier 1970) can be easily distinguished from it congeners by the dark-brown carapace, as long as wide, strongly granulated, setae short and clavate, without eye spots, two wide and deep finely granulated furrows, the mesozone narrows in the middle, between eight to 10 setae on the posterior margin, all the divided tergites except the tergite XI, mostly with six to eight subsequent setae, from the fourth tergite onwards also with marginal setae, all these setae are very denticulate and short, only slightly increasing the length in the last tergites; chelicerae with 5 setae on the hand, *sb* denticulate, serrula exterior with 23 blades, rallum with three blades, galea of the lobe-shaped male with staggered tip, that of the female with 3 lateral branches in the distal half and an apical; genital region of the female, anterior operculum with 14 to 16 short setae, arranged in a triangle, spermatheca consisting of long tubes ending in small expanded sacs; pedipalps very robust and granulated, especially on the medial and dorsal side of the femur, vigorously setae setae, but not as much as the dorsal setae of the body, trochanter only moderately well pronounced, femur shorter than the shell, abrupt, 2.1–2.3×, patella 2.2–2.3×, hand with pedicel 1.5–1.7×, chela with pedicel 2.4–2.9×, fingers thick, slightly shorter than the hand without pedicel, slightly open, densely serrated, on both fingers with three or four accessories teeth each one retrolateral; trichobothrium *est* indistinctly proximal to *ist*, halfway between *isb* and *it*; trichobothrium *it* as far from the tip of the finger as *isb*; trichobothrium *st* closer to *t*, which is only slightly distal to the center of the finger. Legs: leg I femur 1.5–1.7× (1.5–1.8×), patella 1.8–1.9× (1.7–1.9×), tibia 4.4–4.5× (3.6–3.7×), tarsus 6.5–6.7× (5.7–5.9×), leg IV femur+patella 4.1–4.4× (3.8–4.1×), tibia 4.9–5.0× (4.8–4.9×), tarsus 5.3–5.8× (5.5–5.7×) without subterminal tactile setae curved, short smooth, undivided arolia shorter than smooth claws.

Measurements (mm). Measurements of females in parentheses. Body length 1.5–1.6 (2.0–2.2). Carapace 0.51–0.52/0.44–0.46. Pedipalp: trochanter 0.23–0.27/ 0.15–0.17(0.25–0.27/0.17–0.19), femur 0.42–0.44/0.22–0.24(0.44–0.43/0.20–0.21), patella 0.45–0.46/0.21–0.23

(0.46–0.48/0.21–0.22), chela with pedicel: 0.72–0.73/0.35–0.37, hand with pedicel 0.51–0.53/0.35–0.37 (0.52–0.53/0.37–0.39), movable finger 0.39.–0.40(0.37–0.39). Leg I: femur 0.15–0.17/0.10–0.12 (0.17–0.19/0.11–0.12), patella 0.17–0.18/0.10–0.12(0.15–0.17/0.11–0.13), tibia 0.16–0.17/0.06–0.07(0.17–0.19/0.05–0.06), tarsus: 0.22–0.23/0.04–0.05 (0.23–0.25/0.05–0.07). Leg IV: femur+ patella 0.45–0.47/0.14–0.15 (0.54–0.55/0.13–0.14), tibia 0.25–0.27/0.07–0.09 (0.32–0.35/0.07–0.09), tarsus 0.24–0.27/0.05–0.06 (0.33–0.35/0.07–0.09).

Remarks. *Sphenochernes camponoti* was initially described from ant nests in São Paulo, as *Syndeipnochernes camponoti* (Beier 1970: fig. 1), but the species transferred this species to the genus *Sphenochernes* Turk, 1953 by Mahnert (1985). Specimens collected in the Ducke Reserve from Amazonia have been identified as *Sphenochernes* sp. (Mahnert 1985: 229–230; figs 41, 42). Tizo-Pedroso and Lira (2017) reported *S. camponoti* as phoretic on *Fannia* flies in Pernambuco. All our specimens from Buique, both males and females, correspond with Beier's (1970) description of *S. camponoti*. In the absence of a reexamination of the type specimens, we assign our specimens to this species.

Geographical distribution. Brazil (Mahnert 1985b; Harvey 2013; Lira and Tizo-Pedroso 2017).

Comments. The specimens were found during phoresy with specimens flies of the genus *Fannia* sp. (Diptera, Fanniidae).

Discussion

The fauna of pseudoscorpions in Brazil is currently represented by 174 species distributed in 66 genera and 16 families (Table 1). Chernetidae is the most diverse (37%) followed by the Chthoniidae (17%), Withiidae (10%), Ideoroncidae (7%), Syarinidae (6%), Hesperolpiidae (6%), and Cheliferidae (3%). The remainder of the diversity is comprised of the eight families, Atemnidae, Bochicidae, Cheiridiidae, Geogarypidae, Garypinidae, Olpiidae, Pseudochiridiidae, and Feaellidae (Ratton et al. 2012; Harvey 2013; Von Schimonsky et al. 2014; Harvey et al. 2016b; Viana et al. 2018; Von Schimonsky and Bichuette 2019a, 2019b). In Brazil, existing literature has primarily reported on the pseudoscorpions of the Northeast and Southeast regions. The highest species richness of pseudoscorpions in Brazil has been reported from the Amazonia, Mata Atlântica, Pantanal, and Pampa biomes (Fig. 3). We add the Caatinga biome to this list of biodiverse pseudoscorpion regions (Fig. 4) and increase the known distributions of *G. amazonicus*, *A. ecuadorense*, *P. furculiferum*, and *S. camponoti*. Our results likely do not include all pseudoscorpion species living in this biome, and more species may be found with additional sampling.

The global genus *Geogarypus* currently has 48 extant species and three fossil species and is abundant in the tropics and subtropics (Harvey 2013; Novák and Harvey 2018). Currently only ten species are reported for continental South America and adjacent islands (Harvey 2013; Nassirkhani 2014; Neethling and Haddad 2017; Gardini et al. 2017; Novák and Harvey 2018). Of these species, four are known to occur in Brazil: *G. amazonicus* Mahnert, 1979, *G. cuyabanus* (Balzan, 1887), *G. formosus* (Mello-Leitão 1937), *G. paraguayanus* Beier, 1931 (Beier 1931, 1955, 1959; Mello-Leitão 1937; Mahnert 1979; Harvey 2013). In the Caatinga, *G. amazonicus*

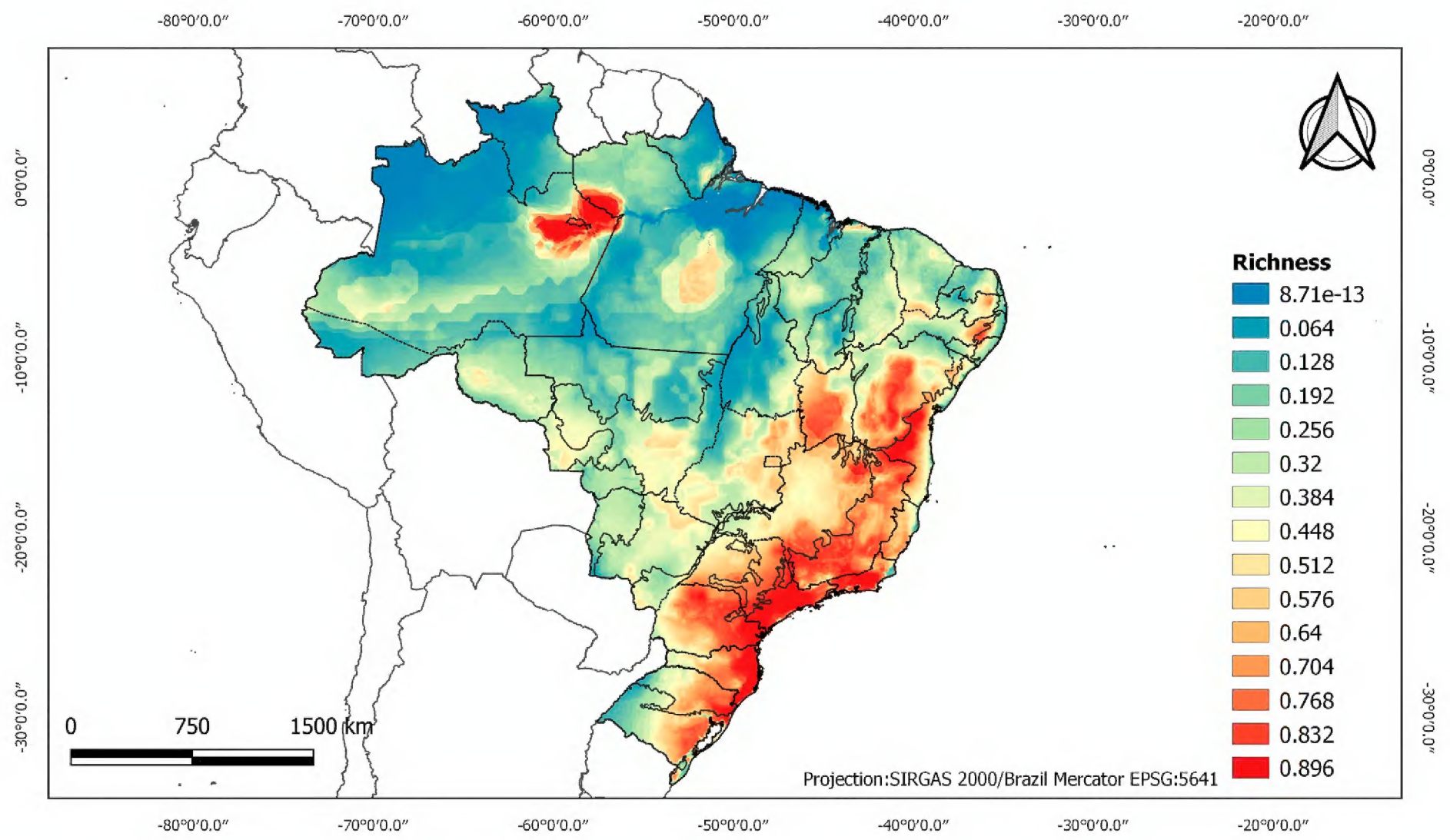

Figure 3. Map representing the distribution of pseudoscorpion species richness across ll families in Brazil.

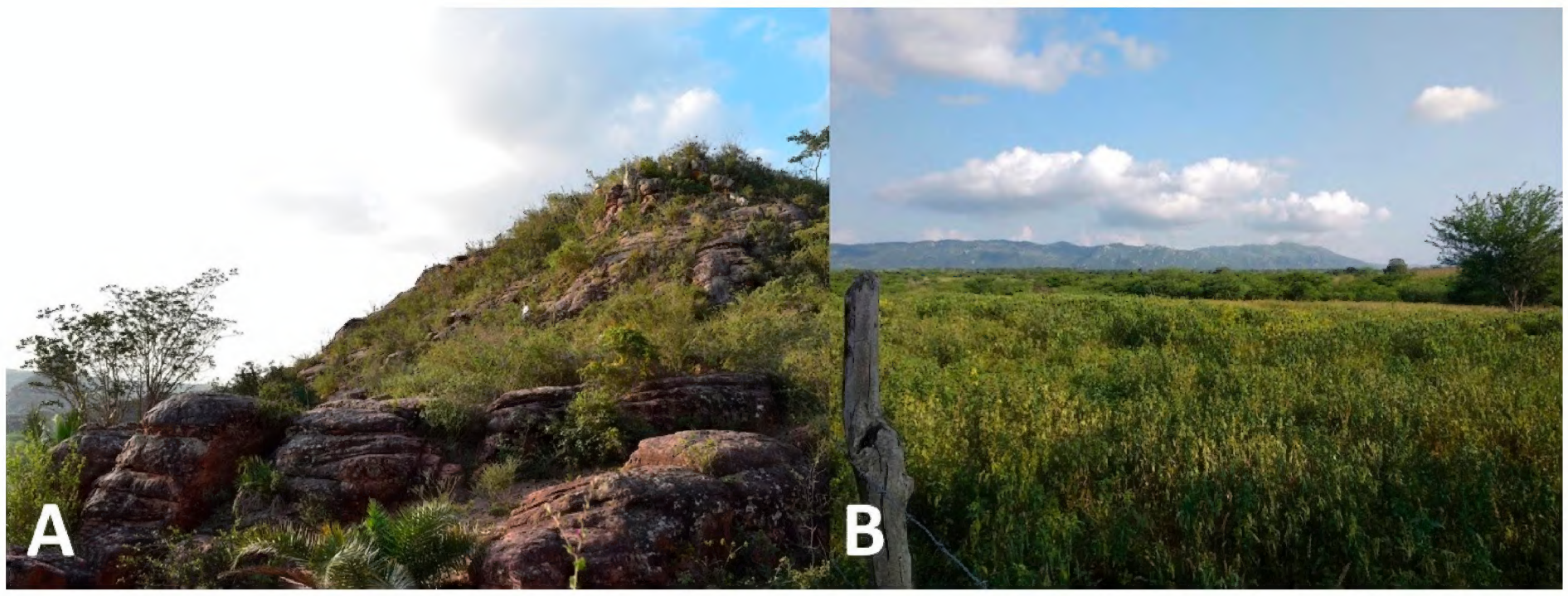

Figure 4. Examples of habitat in the Caatinga biome where pseudoscorpions were found. **A.** Native undisturbed habitat, Buíque. **B.** Pasture, Cumaru. Photos by Lais Pordeus (A) and Meykson Silva (B).

were collected in well-preserved arboreal Caatinga near river springs. *G. amazonicus* is generally considered as a migrant terricolous species, due to its absence on the forest floor. This suggests that this species belongs to the non-migrating arboreal group, which is normally associated with the canopy and epiphytes in the forests of the Amazon (Adis 1981; Adis and Mahnert 1985; de Moráis et al. 1986). However, we found *G. amazonicus* in leaf litter, which suggests that this species might exhibits a great ecological plasticity.

We collected *A. ecuadorense* and *P. furculiferum* under stones in pasture and in suburban areas during the dry season. These species were also collected under stones and fallen logs in a preserved Caating area near a spring. These species belong to the Hesperolpiidae, a mostly Neotropical family that is also known from deserts and other arid habitats in the Nearctic and Palearctic regions (Weygoldt 1969; Lee 1979; Harvey 2013). Hespropiids are well distributed, with a high diversity in xeric habitats in both the continental and insular areas of South America (Weygoldt 1969; Harvey 2013; Cosgrove et al. 2016). The genus *Sphenochernes* Turk, 1953 was initially created for the species *S. schulzi* Turk, 1953, but later two additional species were added: *Chelifer bruchi* Mello-Leitão, 1925 and *Syndeipnochernes camponoti* Beier, 1970. Both species were synonymized with *S. schulzi* by Mahnert (1985a), who labelled specimens from the Ducke Reserve of the Amazon as *Sphenochernes* sp. (Mahnert 1985b: 229–230, figs 41, 42). *Sphenochernes* is currently represented by four species: *S. schulzi*, *S. camponoti* (Beier, 1970), *S. bruchi* (Mello-Leitão 1925), and *S. attazi* Bedoya-Roqueme, 2019; the genus is distributed in Argentina, Brazil, and Colombia (Bedoya-Roqueme 2019). The species of this genus have been found associated with the nests of the ants *Acromyrmex lundi*, *Camponotus rufipes*, and *Atta columbica* (Turk 1953; Beier 1970; Bedoya-Roqueme 2019). *Sphenochernes camponoti* collected in the Caatinga were phoretic on *Fannia* sp. flies. This association in the Caatinga was previously reported by Lira and Tizo-Pedroso (2017).

Of the species we collected, nine species of pseudoscorpions, belonging to five families, are reported from the Caatinga biome. The three species, *G. amazonicus*, *A. ecuadorense*, and *P. furculiferum*, that we newly report from the Caatinga correspond to a third of the described diversity of this biome, but less than 1% of the species reported for Brazil. Although few individuals were collected by us, we consider this study to be a preliminary but informative approximation of the pseudoscorpion fauna in the study area. However, based on the species richness map, certain areas remain to be explored, and it is necessary that more studies be made focusing other methodologies to obtain more thorough data on the pseudoscorpion fauna.

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Authors' Contributions

The paper was conceived by all authors. AFAL and GGR carried out the fieldwork. EBR and ETP processed collected and identified specimens and performed the curatorial work. EBR analyzed the data and made the distribution map. All authors wrote the final version of

the manuscript.

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